SWORN TRANSLATION

I, Hiromitsu Hara, hereby declare and state that I am knowledgeable of each of the English and Japanese languages and that I made the attached translation of the certified copy of Japanese Patent Application No. 2000-5637 from the Japanese language into English language and that I believe my attached translation to be accurate, true and correct to the best of my knowledge and ability.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Hiromitsu Hara

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[Title of the Invention]	Pneumatic tire
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[Identification of Document] Specification

[Title of the Invention] Pneumatic tire

[Claims]

[Claim 1] A pneumatic tire comprising at least one carcass ply containing steel cords therein, which consists of a main body portion toroidally extending from a tread portion through a sidewall portion to a bead portion and a wound portion turned around a bead core embedded in the bead portion, characterized in that

the wound portion of the carcass ply is provided with a wind contact part along the peripheral face of the bead core;

the bead portion is embedded with at least one wire chafer turned from the main body portion of the carcass ply toward the wound portion thereof and around the bead core from an inside toward an outside in a widthwise direction of the tire; and

the wire chafer is arranged so that a start end of the steel cord reinforcing layer located at a side of a main body of the carcass ply is arranged so that a shortest distance (L) measured outward from a normal line (n) drawn at a first rim line position to an outer face of the bead portion in the radial direction of the tire is positioned within a range of 15-25 mm, while a terminal end of the steel cord reinforcing layer located at a side of the wind contact part of the carcass ply is arranged so as to position within a range sandwiched between a vertical line (m) drawn from an outermost end position of the bead core in the radial direction to the outer face of the bead portion and the normal line (n).

[Claim 2] A pneumatic tire according to claim 1, wherein at least one organic fiber chafer is arranged at the side of the wind contact part of the carcass ply so as to cover the terminal end of the steel cord reinforcing layer.

[Claim 3] A pneumatic tire according to claim 2, wherein the organic fiber cords constituting the organic fiber chafer are arranged at a cord angle of 15-75° with respect to an arranging direction of the steel cords constituting the steel cord reinforcing layer.

[Claim 4] A pneumatic tire according to claim 1, 2 or 3, wherein a cushion rubber layer is interposed between the main body of the carcass ply and the start end portion of the steel cord reinforcing layer.

[Claim 5] A pneumatic tire according to claim 4, wherein the cushion rubber layer

at the position of the start end of the steel cord reinforcing layer has a rubber gauge of 1.5-2.0 mm viewing a section in a widthwise direction of the tire.

[Claim 6] A pneumatic tire according to any one of claims 1 to 5, wherein the tire is a heavy duty tire.

[Detailed Explanation of the Invention]

[0001]

[Field of the Invention]

This invention relates to a pneumatic tire, and more particularly to a pneumatic tire having a bead portion durability improved by preventing the getting-out of ply cords and the occurrence of separation at an end position of a turnup portion of a carcass ply but also effectively controling trouble in the bead portion due to a bending deformation of the bead portion using a rim flange as a fulcrum under an action of a higher load. Moreover, the invention is preferable to be applied to a so-called heavy duty pneumatic radial tire used under conditions of high load and high internal pressure such as truck, bus and the like.

[0002]

[Prior Art]

In the pneumatic radial tire, it is general that in order to prevent the getting-out of ply cords during the running of the tire under loading, as shown in Fig. 4(a), a carcass ply 100 is largely wound around a bead core 102 in a bead portion 101 from an inside toward an outside in a widthwise direction of the tire and a turnup portion 103 thereof is fixed by embedding in rubber.

[0003]

[Problems to be solved by the invention]

In the conventional tire having such a bead portion structure, however, a sidewall portion 104 is subjected to a large bending deformation during the running of the tire under loading, particularly under an action of a higher load, and a pulling force F in an arrow direction of Fig. 4(a) is applied to the carcass ply 100 accompanied therewith and also a stepwise difference in rigidity is produced at an end position 105 of the turnup portion 103 of the carcass ply 100 inward and outward in a radial direction of the tire to repeatedly cause stress concentration in the end position 105 and in the vicinity thereof, whereby separation of the ply cord from rubber is easily caused and there is a problem that this separation causes a bead

portion crack Cr as shown in Fig. 4(b).

[0004]

As a countermeasure for preventing the separation to improve the bead portion durability, the applicant proposed in the previously filed Japanese Patent Application No. 11-19847 or the like that it is useful to arrange a wind contact part 109 along a peripheral face of the bead core 108 in the turnup portion 107 of the carcass ply 106 as shown in Fig. 5(a).

[0005]

However, when a reinforcing layer such as a wire chafer or the like is not arranged in the bead portion, if a high load is applied to the tire, as shown by a phantom line in Fig. 9(b), a large bending deformation in a direction of an arrow A is caused around a rim flange 110 as a fulcrum and cracks are easily produced in the bead portion of the tire contacting with the rim flange by the repetition of this bending deformation, and the cracks grow to cause a risk of producing trouble of bead portion in a worst case.

[0006]

Further, as a countermeasure for improving the bead portion durability of the tire having the above bead portion structure, as shown in Fig. 6(a), it is useful to control the bending deformation of the bead portion under the action of applying a higher load to the tire by arranging at least one reinforcing layer 112 wound around the bead core 111 at an outside position of the carcass ply 110 from an inside toward an outside in the widthwise direction in the bead portion.

[0007]

As shown in Fig. 6(b), however, stress concentrates in an end position 113 of the reinforcing layer 112 and there is feared the occurrence of troubles such as bead portion crack Cr and the like, and finally the bead portion durability can not be effectively enhanced.

[0008]

It is, therefore, an object of the invention to provide a pneumatic tire having a bead portion durability improved by preventing the getting-out of ply cords and the occurrence of separation at an end position of a turnup portion of a carcass ply but also effectively controling trouble in the bead portion due to a bending deformation of the bead portion using a rim flange as a fulcrum under an action of a

higher load.

[0009]

[Means for solving problems]

In order to achieve the above object, the pneumatic tire of the invention lies in a pneumatic tire comprising at least one carcass ply containing steel cords therein, which consists of a main body portion toroidally extending from a tread portion through a sidewall portion to a bead portion and a wound portion turned around a bead core embedded in the bead portion, characterized in that the wound portion of the carcass ply is provided with a wind contact part along the peripheral face of the bead core; the bead portion is embedded with at least one wire chafer turned from the main body portion of the carcass ply toward the wound portion thereof and around the bead core from an inside toward an outside in a widthwise direction of the tire; and the wire chafer is arranged so that a start end of the steel cord reinforcing layer located at a side of a main body of the carcass ply is arranged so that a shortest distance measured outward from a normal line drawn at a first rim line position to an outer face of the bead portion in the radial direction of the tire is positioned within a range of 15-25 mm, while a terminal end of the steel cord reinforcing layer located at a side of the wind contact part of the carcass ply is arranged so as to position within a range sandwiched between a vertical line drawn from an outermost end position of the bead core in the radial direction to the outer face of the bead portion and the normal line.

[0010]

The term "first rim line position" used herein means an outermost end of an outer surface portion of the tire contacting with a rim in the radial direction when the tire is assembled onto a standard rim and a maximum air pressure and a maximum load capacity are applied thereto.

[0011]

The term "turnup portion of carcass ply" used herein includes a case that it is wound from an outside toward an inside in the widthwise direction in addition to a case that it is wound from the inside toward the outside in the widthwise direction.

[0012]

In addition, the carcass ply means to include not only a case that many

steel cords having both cut ends are arranged substantially in the radial direction but also a case that one steel cord is folded at a wound portion of the carcass ply and extended while meandering in a circumferential direction of the tire.

[0013]

When it is required to more control the occurrence of separation at the terminal end position of the wire chafer, it is preferable that at least one organic fiber chafer is arranged at the side of the wind contact part of the carcass ply so as to cover the terminal end of the steel cord reinforcing layer. Also, it is more preferable that the organic fiber cords constituting the organic fiber chafer are arranged at a cord angle of 15-75° with respect to an arranging direction of the steel cords constituting the steel cord reinforcing layer.

[0014]

When it is required to more control the separation at the start end position of the wire chafer, it is preferable that a cushion rubber layer is interposed between the main body of the carcass ply and the start end portion of the steel cord reinforcing layer. In this case, it is more preferable that the cushion rubber layer at the position of the start end of the steel cord reinforcing layer has a rubber gauge of 1.5-2.0 mm viewing a section in a widthwise direction of the tire.

[0015]

Also, the tire is preferable to be a heavy duty tire.

[0016]

[Embodiments of the invention]

An embodiment of the invention will be described with reference to the accompanying drawings below.

In Fig. 1 is sectionally shown an embodiment of the bead portion in the pneumatic tire according to the invention. Numeral 1 is a bead portion, numeral 2 a carcass ply, numeral 3 a sidewall portion, numeral 4 a bead core and numeral 5 a wire chafer.

[0017]

In the tire having the bead portion 1 shown in Fig. 1, at least one carcass ply 2 of rubberized steel cords preferably arranged substantially in a radial direction (concretely in a direction of about 70-90° with respect to an equatorial plane of the tire) consists of a main body portion 2a toroidally extending from a tread portion

(not shown) through the sidewall portion 3 to the bead portion 1, and a wound portion 2b wound around the bead core 4 embedded in the bead portion 1. Also, a belt (not shown) comprised of one or more rubberized cord layers is arranged on a crown portion (not shown) of the carcass ply 2 for reinforcing the tread portion.

[0018]

A main feature in the construction of the invention lies in the adoption of the bead structure winding the carcass ply 2 around the bead core 4 and further the arrangement of rationalized wire chafer 5 for controling the bending deformation of the bead portion in the action of a higher load to the tire, more concretely the arrangement of a wind contact part 6 wound along an outer peripheral face of the bead core 4 in the wound portion 2b of the carcass ply 2. By adopting this feature can be considerably improved the bead portion durability.

[0019]

That is, the getting-out of carcass ply 2 and the occurrence of separation at a wound terminal end position 8 of the carcass ply 2 can be prevented by winding the carcass ply 2 around the bead core 4. Also, the bead portion is considerably strengthened as compared with the conventional tire having the usual turnup structure (Fig. 4(a)).

[0020]

However, when a higher load is applied to the tire, a large bending deformation using a rim flange as a fulcrum can not be effectively controled only by the above structure, and crack is easily produced in the bead portion 1 of the tire contacting with the rim flange 14 by repetition of this bending deformation.

[0021]

For this end, according to the invention, at least one wire chafer 5 is arranged in the bead portion 1 so as to extend from the main body portion 2a of the carcass ply 2 toward the wound portion 2b thereof and wind around the bead core 4 from an inside of the tire toward an outside thereof in a widthwise direction 7, wherein a start end 8 of the wire chafer 5 located at the side of the main body portion 2a of the carcass ply 2 is arranged so that a shortest distance L measured outward from a normal line n drawn at a first rim line position 9 to an outer face 13 of the bead portion 1 in a radial direction 10 of the tire is positioned within a range of 15-25 mm, while a terminal end 11 thereof located at the side of the wound

portion 2b of the carcass ply 2 is arranged so as to position within a range sandwiched between a vertical line m drawn from an outermost end position 12 of the bead core 4 in the radial direction to the outer face 13 of the bead portion 1 and the above normal line n. Thus, the above bending deformation can effectively be controlled to considerably improve the bead portion durability.

[0022]

The reason why the start end 8 of the wire chafer 5 is positioned within the range of shortest distance L of 15-25 mm is due to the fact that when the shortest distance L is less than 15 mm, the circumferential deformation of the carcass ply can not sufficiently be controlled and hence the bending rigidity of the bead portion becomes large to easily cause troubles in the bead portion, while when the shortest distance L exceeds 25 mm, the start end 8 approaches to a flex zone of the tire, particularly low-section profile tire and hence stress concentrates in the start end 8 position of the wire chafer 5 to easily cause separation failure.

[0023]

On the other hand, the reason why the terminal end 11 of the wire chafer 5 is positioned between the vertical line n and the normal line m drawn from outermost end position 12 in the radial direction of the bead core 4 to the outer face 13 of the bead portion 1 is due to the fact that when the terminal end 11 is located down ward from the vertical line m in the radial direction 10 of the tire, the wound portion 2b of the carcass ply 2 can not sufficiently be protected and separation failure at an interface between the terminal end 11 and the wound portion 2b is apt to be caused, while when the terminal end 11 is located upward from the normal line n in the radial direction 10 of the tire, a large shearing strain is applied to the terminal end 11 to easily cause troubles in the bead portion.

[0024]

In the invention, therefore, the bead portion durability can be considerably improved by adopting the above construction.

[0025]

As another embodiment, at least one (two in Fig. 2) organic fiber chafer 15a, 15b covering a terminal end 14 of the wire chafer 5 may be arranged at the side of the wound portion 2b of the carcass ply 2 as shown in Fig. 2. In this case, shearing strain at the terminal end 14 of the wire chafer 5 can be more controlled to

further improve the bead portion durability.

[0026]

When organic fiber cords 16 in the organic fiber chafers 15a, 15b are arranged at a cord angle of 15-75° with respect to a cord arranging direction of the wire chafer 5, they can bear force applied from various directions to the terminal end portion 5b of the wire chafer 5 and hence shearing strain at the terminal end 14 of the wire chafer 5 can be more controlled.

[0027]

In case that it is required to more control the separation failure at the start end 8 of the wire chafer 5, as shown in Fig. 3, a cushion rubber layer 18 may be interposed between the main body portion 2a of the carcass ply 2 and the star end portion 5a of the wire chafer 5.

[0028]

Moreover, it is favorable that a rubber gauge t of the cushion rubber layer 18 at a position corresponding to the start end 8 of the wire chafer 5 is 1.5-2.0 mm at a section in the widthwise direction of the tire. When the rubber gauge t is less than 1.5 mm, the effect of controlling separation failure by arranging the cushion rubber layer 18 can not sufficiently be obtained, while when the rubber gauge t exceeds 2.0 mm, there is cased a fear that the effect of controlling the circumferential deformation by the wire chafer 5 can not sufficiently be obtained.

[0029]

Although the above merely shows an embodiment of the invention, various modifications may be conducted within a scope of the claim.

[0030]

[Example]

A pneumatic tire according to the invention is prepared and a bead portion durability thereof is evaluated as explained below.

[0031]

There are provided pneumatic tires of Examples 1-7 having a tire size of TBR 315/60R22.5, in which positions of start end 8 and terminal end 14 of wire chafer 5, presence or absence and rubber gauge t of cushion rubber layer 18, presence or absence and cord angle of organic fiber chafer are shown in Table 1.

[0032]

For the comparison, there are provided a conventional tire having a usual turnup structure of a carcass ply (conventional example) and comparative tires (Comparative Examples 1-5) wherein the bead portion has a winding structure and a wire chafer is arranged but either start end position 8 or terminal end position 11 of the wire chafer is outside the proper range defined in the invention.

[0033]

(Test Method)

The tire to be tested is assembled onto a rim of 9.00 x 22.5 and thereafter the bead portion durability is evaluated.

[0034]

A test for measuring circumferential deformation and a drum test for bead portion durability are conducted, and the bead portion durability is evaluated from the results.

[0035]

In the test for measuring the circumferential deformation, a circumferential displacement is measured under a condition that the tire is freely pushed down by a force 66.15 kN from the top, and it is evaluated from the measured value

[0036]

In the drum test for bead portion durability, the tire is run on a rotating drum at a speed of 60 km/h under conditions of internal pressure: 900 kPa and load: 66.15 kN to measure a running distance until the occurrence of tire trouble, and it is evaluated from the measured value.

[0037]

The evaluated results are shown in Table 1. Moreover, the numerical values in Table 1 are represented by an index on the basis that the conventional example is 100, in which the smaller the value, the better the circumferential deformation index, while the larger the value, the better the drum test index for bead portion durability.

[0034]

[Table 1]

	Wire chafer 5		Cushion rubber layer 18		Organic fiber chafer		Bead portion durability	
	position of start end 8	position of terminal end 11	arrangement	rubber gauge	arrangement	cord angle	index of circumferential deformation	index of drum test for bead portion durability
Conventional tire	L = 0 mm	normal line n + 10 mm	absence	–	absence	–	100	100
Comparative Example 1	L = +30 mm	normal line n – 5 mm	presence	1.5	absence	–	61	105 (peculiar trouble)
Comparative Example 2	L = +20 mm	vertical line m– 5 mm	absence	–	absence	–	80	105 (peculiar trouble)
Comparative Example 3	L = +20 mm	normal line n + 5 mm	presence	1.0	absence	–	81	110 (peculiar trouble)
Comparative Example 4	L = +20 mm	normal line n + 5 mm	presence	2.5	absence	–	90	112 (peculiar trouble)
Comparative Example 5	L = +20 mm	vertical line m – 5 mm	absence	–	absence	–	55	88 (peculiar trouble)
Example 1	L = +15 mm	normal line n – 5 mm	presence	1.5	absence	–	89	158
Example 2	L = +20 mm	normal line n – 5 mm	presence	2.0	absence	–	83	192
Example 3	L = +25 mm	normal line n – 5 mm	presence	1.5	absence	–	77	173
Example 4	L = +20 mm	on normal line n	absence	–	absence	–	75	121
Example 5	L = +20 mm	normal line n – 5 mm	absence	–	absence	–	69	140
Example 6	L = +20 mm	on vertical line m	absence	–	absence	–	64	152
Example 7	L = +20 mm	on normal line n	absence	–	presence *1	±45°	52	170

*1 : Two nylon chafers, shortest distance between m and n is 10 mm.

[0035]

As seen from the evaluation results shown in Table 1, Examples 1-7 are excellent in the bead portion durability as compared with the conventional example. On the other hand, peculiar trouble is caused when Comparative Examples 1-5 are subjected to the drum test for bead portion durability.

[0036]

[Effect of the Invention]

According to the invention, there can be provided pneumatic tires having an excellent bead portion durability. Moreover, the invention is suitable for pneumatic radial tires used in heavy duty vehicles such as truck, bus and the like running under higher internal pressure and load.

[Brief Description of the Drawings]

[Fig. 1] is a cross-section view illustrating a state of assembling a bead portion of the pneumatic tire according to the invention onto a rim.

[Fig. 2] is a diagrammatic view illustrating another embodiment.

[Fig. 3] is a diagrammatic view illustrating the other embodiment.

[Fig. 4] is a view for explaining a problem of the conventional bead structure.

[Fig. 5] is a view for explaining a problem produced when adopting a bead structure of winding a carcass ply around a bead core.

[Fig. 6] is a view for explaining a problem produced at a terminal end position of a wire chafer arranged for reinforcing a bead portion of Fig. 5.

[Description of Reference Symbols]

1 bead portion
2 carcass ply
3 sidewall portion
4 bead core
5 wire chafer
6 wind contact part
7 widthwise direction of tire
8 start end of wire chafer
9 first rim line
10 radial direction of tire
11 terminal end of wire chafer

12 outermost position of bead core in radial direction

13 outer face of bead portion

14 rim flange

15a, 15b organic fiber chafer

16 cord of organic fiber chafer

17 cord of wire chafer

18 cushion rubber layer

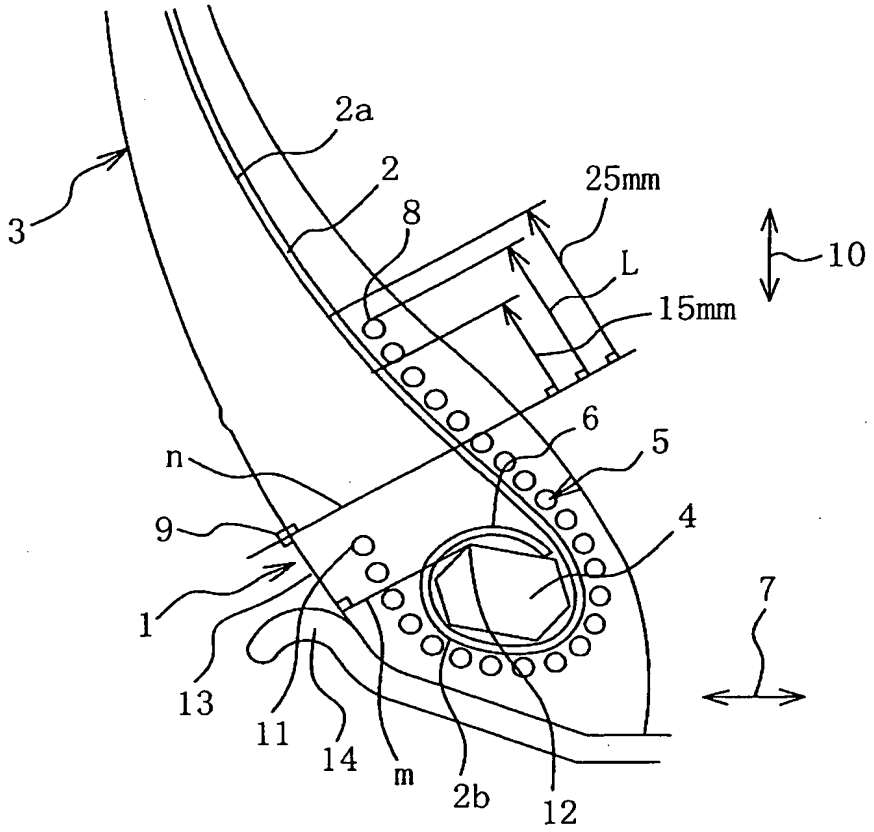
m vertical line

n normal line

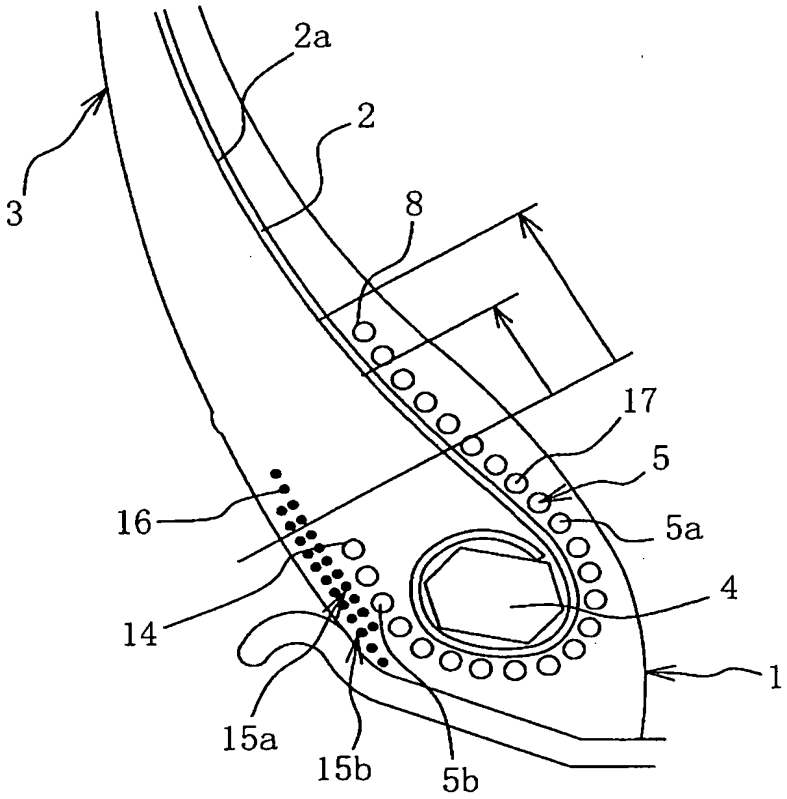
t gauge of cushion rubber layer measured at start end position of wire chafer

L shortest distance measured from normal line n in radial direction of tire

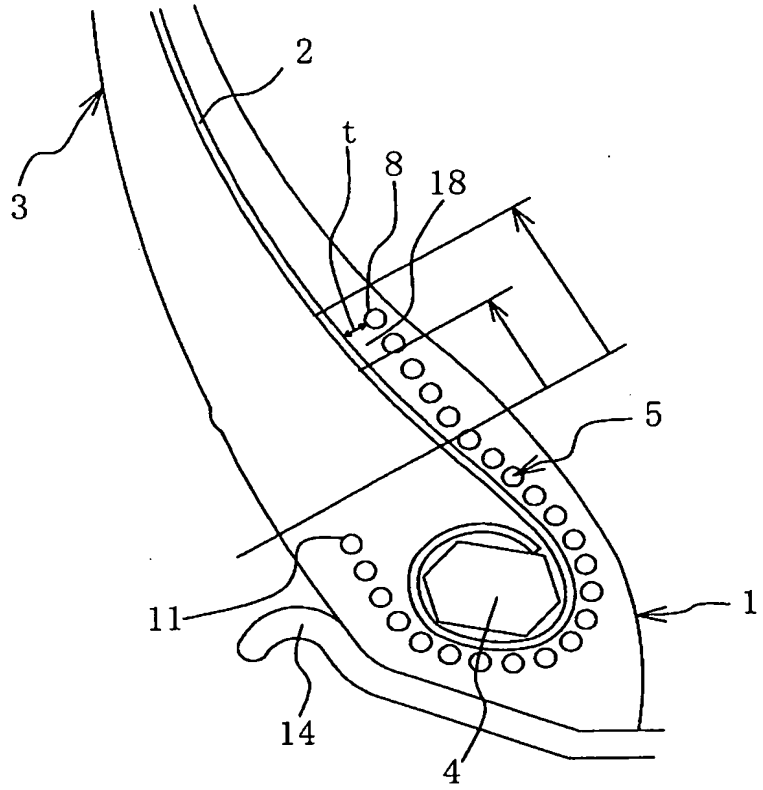
【書類名】　　図面
[Identification of Document]　Drawing
【図１】
[Fig. 1]



【図２】
[Fig. 2]



【図３】
[Fig. 3]



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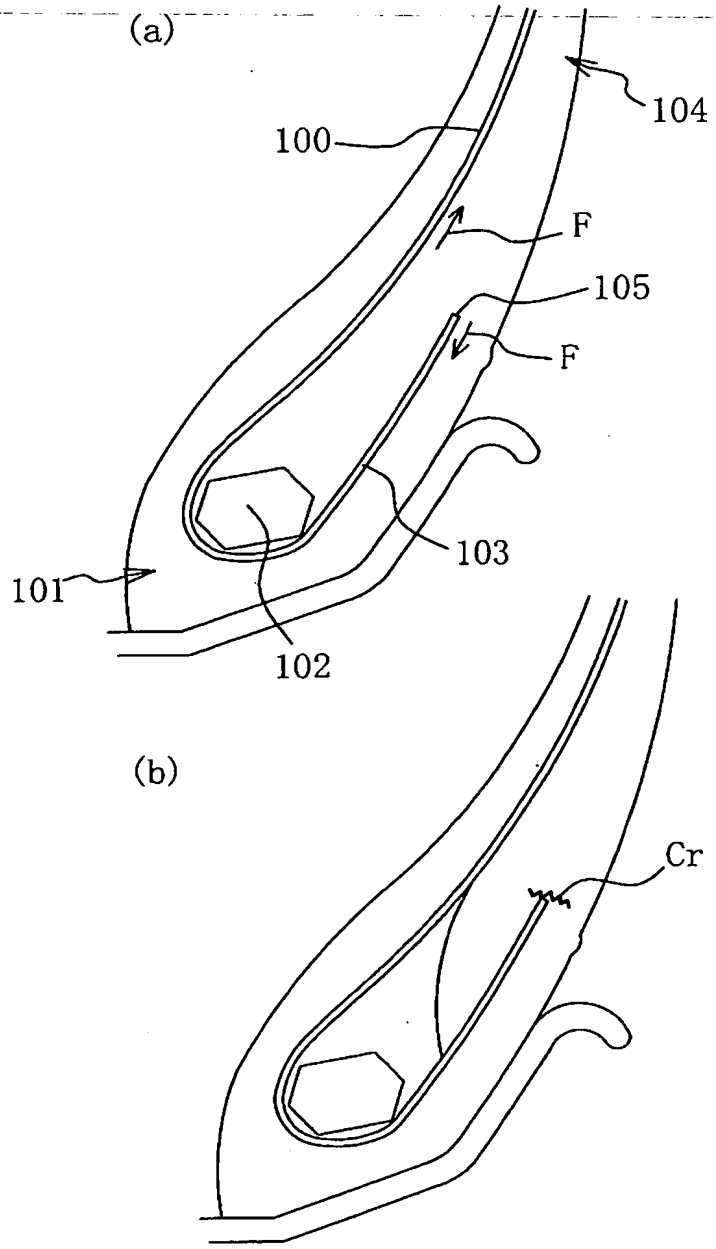
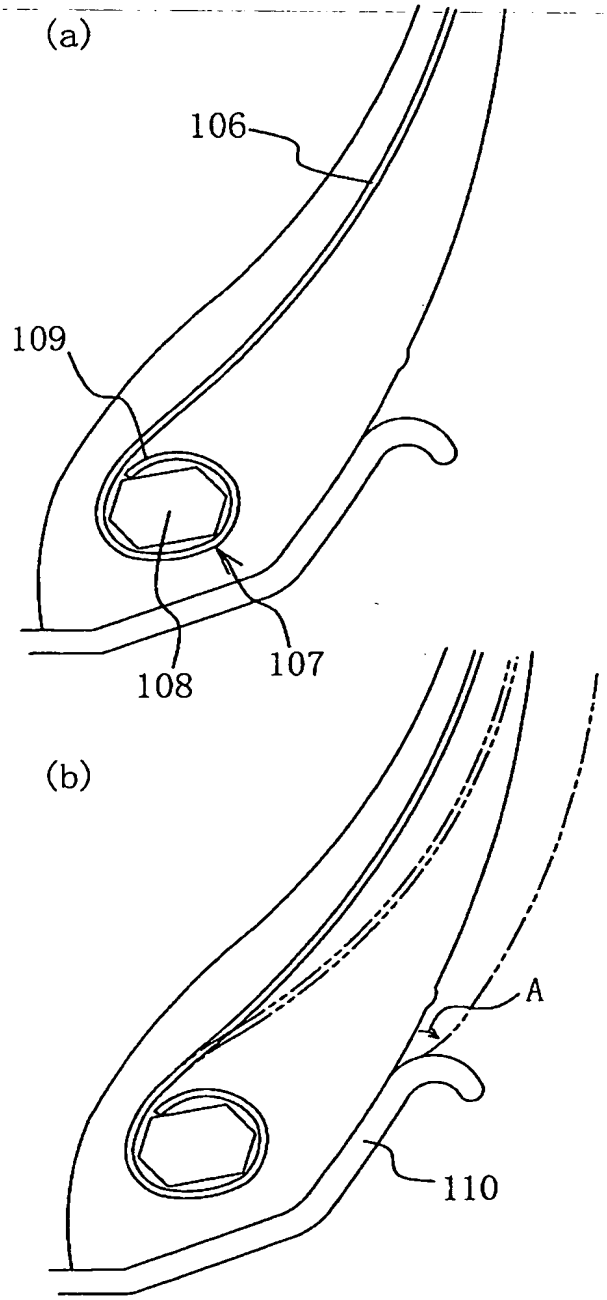
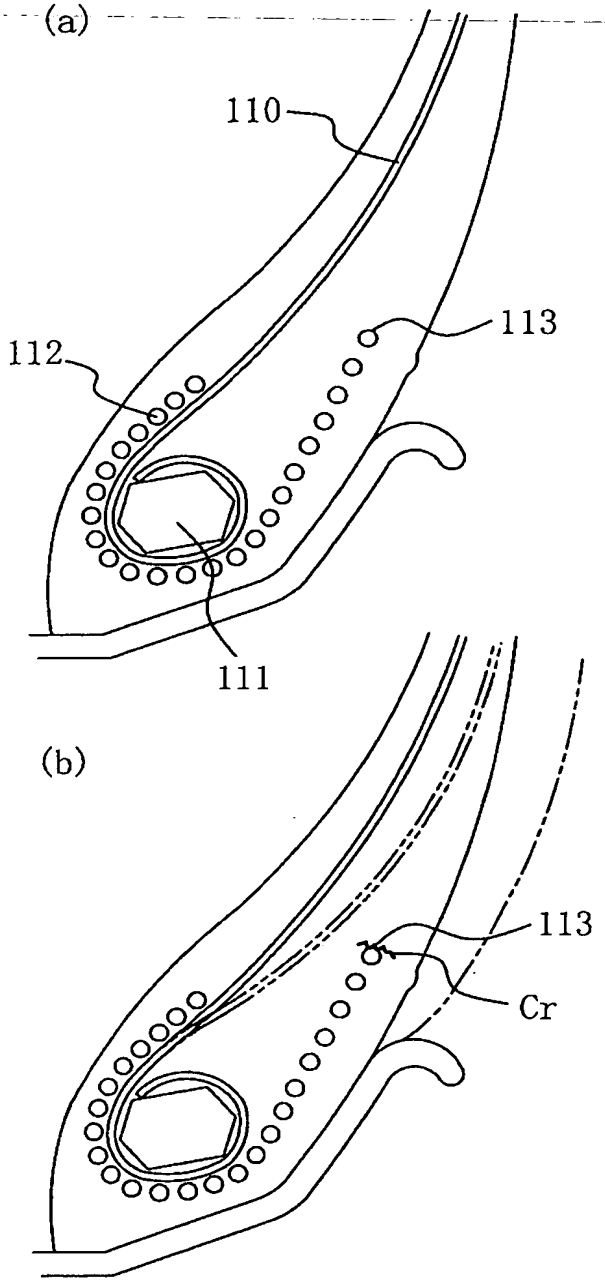
[Fig. 4]



【図５】
[Fig. 5]



【図６】
[Fig. 6]



[Identification of Document] ABSTRACT

[Abstract]

[Object] It is to provide a pneumatic tire improving a bead portion durability.

[Means for solution] At least one carcass ply 2 consists of a main body portion 2a and a wound portion 2b, and a wind contact part 6 along an outer peripheral surface of a bead core 4 is disposed in the wound portion 2b of the carcass ply 2, and at least one wire chafer 5 wound around the bead core 4 is embedded in the bead portion 1, and the wire chafer 5 is arranged so that a start end 8 thereof is arranged so that a shortest distance L measured outward from a normal line n drawn at a first rim line position 9 to an outer face 13 of the bead portion in the radial direction 10 of the tire is positioned within a range of 15-25 mm, while a terminal end 11 thereof is arranged so as to position within a range sandwiched between a vertical line m drawn from an outermost end position 12 of the bead core 4 in the radial direction to the outer face 13 of the bead portion and the normal line n.

[Selected Figure] Fig. 1